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re-elected during the remainder of his life. He thus held the office for twenty-five years. Prince George of Denmark, the queen's husband, who was a fellow of the Royal Society, was deeply impressed by Newton's genius. The queen, accordingly, wished to honor her greatest subject. In April, 1705, she held court at Trinity lodge and conferred knighthood upon Newton. At the court of George I. Newton was a very popular visitor.

From an early period of his life Newton had paid great attention to theological studies, and it is well known that he had begun to study the prophecies before 1690. M. Biot, with a view of showing that his theological writings were the production of his dotage, fixed their date between 1712 and 1719. That Newton's mind was even then quite clear and powerful is sufficiently proved by his ability to attack the most difficult mathematical problems with success. For in 1716 Leibnitz proposed a problem for solution "for the purpose of feeling the pulse of English analysts." The problem was to find the orthogonal trajectories of a series of curves represented by a single equation. Newton received this problem about 5 o'clock in the afternoon, but, though fatigued with business, he solved the problem the same evening.

He left a number of biblical and theological dissertations.

After a painful illness endured with great patience, he died in the eighty-fifth year of his age, on March 20th, 1726.

In preparing this sketch the following works have been consulted: Cantor's *Gaschicte der Mathematik*; Ball's *A Short History of Mathematics*; Cajori's *History of Mathematics*, and the *Encyclopedia Britannica*.

ON THE UTILITY OF STUDYING NON-EUCLIDEAN GEOMETRY.

By P. BARBARIN.

I. The question of the foundation of the theory of parallels has been one of the most interesting scientific preoccupations of this century; it has caused to gush forth torrents of works and given subject to remarkable researches.

Thanks to the theorems of Legendre, to the works of the two Bolyai, of Lobachevski, and of Riemann, of Poincaré, Flye St. Marie, Klein, De Tilly, etc., we cannot any more be deceived on the true import of the celebrated proposition which bears the name of *Postulate of Euclid.*

1st. This is not in any way contained in the classical definitions of the straight and the plane;

2d. This is, among three hypotheses equally admissible, and which cannot all be rejected, only the most simple.

Is it perhaps the single case which has given to the grand Greek geometer the choice of his system of geometry? or has he perceived, at least in part, the difficulties and the greater theoretic complication of the other two? We shall never know with certainty. But in the presence of his work so perfect and so rigorous, one thing appears however to be beyond doubt: the post which he assigned to his postulate, the enunciation which he gave of it, attest that this proposition had in his eyes only the value of an hypothesis; without that, he would have formulated it in other terms and would have attempted to demonstrate it.

The ideas of Lobachevski and of Riemann were diffused only very slowly. They were spread above all thanks to the translations of Hoüel. This scientist, whose activity and power of work were prodigious, could not resist the desire to learn all the European languages with the aim of being able to read in their original text, and then to make known to his contemporaries, the most celebrated mathematical works. He admired Lobachevski, whom he surnamed *the modern Euclid*, and in his course professed at the scientific faculty of Bordeaux, he did not neglect any occasion to put him in evidence.

II. Hoüel was persuaded that the knowledge of the non-Euclidean geometry is indispensable for possessing to the bottom the mechanism of the Euclidean geometry. Notwithstanding its paradoxical form, this idea is most just.

General geometry or *Metageometry* contains in fact a great number of propositions common to all the systems, and which should be enunciated with the same terms in each of these.

If the general proposition can be demonstrated also in these general terms, these ought to be preferred even when, to reach this, it is necessary to subject the ordinary form to some modifications.

To cite only one example, we take the convex quadrilateral inscribed in a circle.

In Euclidean geometry, *the sum of two opposite angles is constant and equal to two right angles;* in non-Euclidean geometry *this sum is variable.* Notwithstanding that, the two forms may be conciliated, since in the two cases *the sum of two opposite angles equals that of the other two*, and this is sufficiant to make a convex qualrilateral inscriptible.

Confronting the proposition with that concerning the circumscribed quadrilateral, we put in full light a correlation which *a priori*, ought evidently to exist.

This correlation, which is the foundation itself of general geometry, and which does not always appear in the ordinary geometry with the same clearness, can be utilized for finding new properties of the figures.

EXAMPLE. *Every conic is the locus of points such that the sum of the tangents from these drawn to two circles is constant;* every conic will then be also *the curve envelope of the straights which cut two given circles under angles of which the sum is constant.* (Excellent problem for direct investigation).

III. Is it proper to associate non-Euclidean geometry with teaching, and in what measure?

If it is a question of higher instruction, with ardor we answer affirmatively. In the courses of higher geometry in the Universities the names of Bolyai, Lobachevski, Riemann have their assigned place, and there are yet divers unexplored domains on the road which these scientists have opened.

In so far as referring to the secondary instruction, the question is more delicate. The programs of the preparatory courses of the higher schools contain all, or almost all. special mathematics and spherical geometry. It would not be then a great inconvenience to make there from time to time a discrete allusion to general geometry: on the contrary, the attention of the pupils and their critical spirit would be kept awake by the necessity of investigating if the special proposition which is expounded to them be of order particular or general.

Two indispensable conditions alone should be satisfied ; it is requisite :

1st. *That in all the books put in the hand of the pupils, the hypothetical character of the postulate of Euclid should be well put in relief.*

In my classes I recur with success to the simple proceeding which follows, and which I recommend. Take the straight AB and the two equal perpendiculars AC, BD: the angles ACD, BDC are equal and may be right, acute, or obtuse.

But whichever may be that among these three hypotheses which we assume for this particular quadrilateral, we must conserve it for *all* the other like quadrilaterals. We choose the system of geometry in which these are right, and which corresponds to the Euclidean hypothesis.

2d. *That the invertibility of the postulate of Euclid be cut out of all the demonstrations in which it can be done without, and where however it is wrongly used.* See, for example, the theorem on the sum of the faces of a trihedral or polyhedral angle.

We should recognize that many efforts have been made in these latter years, in the sense indicated. If the notions of general geometry tend to become popular, the honor of it is due above all to the periodicals which have given their hospitality, and in special mode to *Mathesis*, so well directed by our excellent confrere *P. Mansion* of Gand.

In the course of the last eight or ten years this journal has published numerous articles on metageometry written with equal competence and good sense. We advise students to read them.

[Written by P. Barbarin for *Le Matematiche*, and translated by the English Editor G. B. Halsted].

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REDUCED NUMBERS.

By **A. LATHAM BAKER, Ph. D., University of Rochester, Rochester, N. Y.**

The facts of this article are not new, but the presentation is novel and much more direct and simple than any other with which I am acquainted. The